PACKING CALIFORNIA MATURE GREEN TOMATOES
Costs and Efficiencies

PACKING CALIFORNIA MATURE GREEN TOMATOES: COST AND EFFICIENCIES. By Edward
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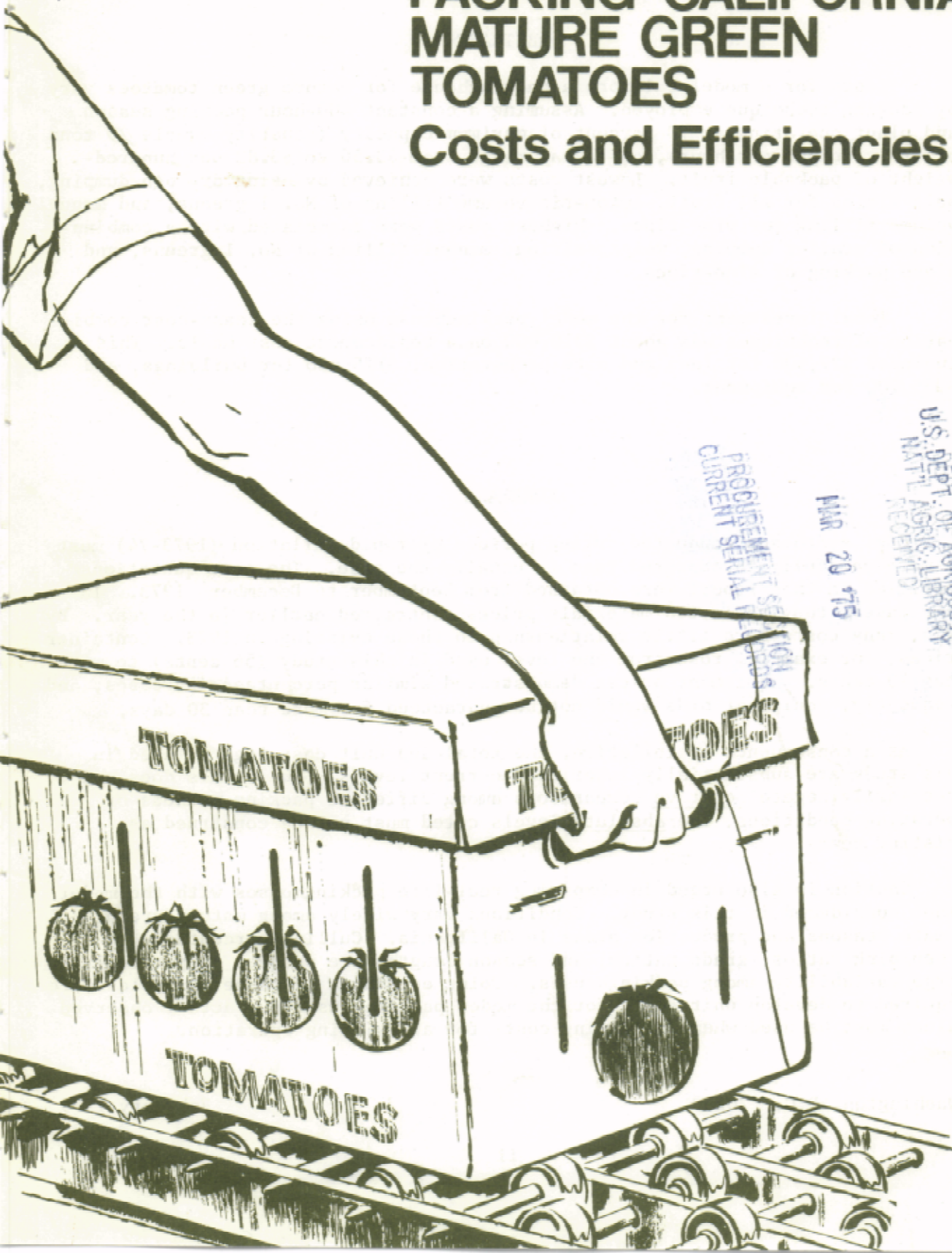
ABSTRACT

     Costs for a model California packinghouse for mature green tomatoes vary
by packing'technique employed. Assuming a constant 400-hour packing season
and plant operating at 70 percent of maximum capacity (capacity equals 30 tons
of fruit dumped per hour), costs may range from $3.56 to $3.82 per hundred-
weight of packable fruit. Lowest costs were achieved by using dry bin dumping,
belt sizing for all fruit, automatic volume filling of No. 1 greens, and manual
volume filling for vine-ripes. Highest costs were associated with a combina-
tion of trailer dumping, weight sizing, manual filling of No. 1 greens, and
place packing of vine-ripes.

     Total investment for the model packinghouse using the least-cost combi-
nation of techniques was about $310,000 on a replacement cost basis. This
included $27,500 for land and site preparation, $125,450 for buildings, and
$155,700 for equipment.

FOREWARD

     Cost syntheses conducted during periods of rapid inflation (1973-74) must
be more carefully interpreted than is usually the case. The cost quotations
specified in this report were obtained from September to December 1973.   In
some cases, they reflected materials prices contracted earlier in the year. By
1974, many costs bore little relationship to those existing in 1973. Container
prices, for example, rose from the level used in this study (56 cents) to more
than 70 cents. Equipment prices demonstrated similar percentage increases, and
frequently, equipment bids would not be guaranteed for more than 30 days.

     As a consequence of inflation, the total and unit cost figures used in
this study are substantially lower than current levels. While this does not
necessarily negate relative comparisons among different packing methods or
operating conditions, the absolute levels cited must not be construed as
existing costs.

     Caution is also urged in comparing real-life packinghouses with the model
plant considered in this study. Conditions vary widely among mature green
tomato seasons and production areas in California. Culling percentages,
green/pink ratios, grade ratios, and season lengths are subject to particularly
large variability among packinghouses. Point estimates of these variables were
required to develop unit costs for the model packinghouse, but actual observed
values must be used when evaluating costs for an existing operation.

Washington, D.C. 20250   February 1975

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SUMMARY

Costs for a model California packinghouse for mature green tomatoes vary according to packing technique. Assuming a constant 400-hour ·packing season and plant operation at 70 percent of maximum capacity (capacity equals 30 tons of fruit dumped per hour), costs may range from $3.56 to $3.82 per hundredweight of packable fruit.

For the model packinghouse, lowest costs were achieved by using dry bin dumping, belt sizing for all fruit, automatic volume filling of No. 1 greens, and manual volume filling for vine-ripes. Highest costs were associated with a combination of trailer dumping, weight sizing, manual filling of No. 1 greens, and place packing of vine-ripes.

Trailer-dumping costs exceeded bin-dumping costs at all levels of output considered. But the analysis did not consider possible cost savings in the field attributable to using trailers. Furthermore, fixed costs for trailer dumping would not appreciably increase at substantially larger volumes than used for the model. This implies that trailer dumping could result in lower costs in packinghouses larger than the model 30-tons-per-hour unit.

Packing costs for weight sizing were only slightly above those of belt sizing. This comparison suggests that the choice of sizer type may be dependent on performance and fruit quality considerations rather than ownership and operating costs.

Except at very low output levels (less than 100 hours operation), the use of automatic fillers for first-grade greens resulted in lower packing costs than using manual fillers. Substitution of automatic for manual fillers released seven workers while increasing ownership costs by about $1,600.

Place packing vine-ripes was shown to be expensive compared with volume filling, increasing unit costs for all fruit by about 17.5 cents per hundredweight packed for a 400-hour season. The feasibility of place packing, at least in the design of new packinghouses, is contingent upon assurance that the price premium for place-packed fruit would equal or exceed this cost disadvantage.

Mature green tomato packing costs dropped sharply as season length was initially increased from short time spans, but leveled off as the season went beyond 6 to 8 weeks. Between 100 and 400 hours, packing costs for the model (using minimum cost techniques and assuming 70 percent of potential packout) dropped 60 cents per 30-pound box. Between 400 and 1,000 hours, the decline was only about 12 cents.

Total investment for the model packinghouse using the least-cost combination of techniques was about $310,000 on a replacement cost basis. This included $27,500 for land and site preparation, $125,450 for buildings, and $155,700 for equipment.

PACKING CALIFORNIA MATURE GREEN TOMATOES
Costs and Efficiencies

Edward V. Jesse [1]

INTRODUCTION

Mature green and vine-ripe tomatoes contributed about equally to California's 1973 fresh tomato volume of 19.4 million hundredweight [2]--about one-third of U.S. production. In contrast to vine-ripe tomatoes, which are picked after they have begun to show a definite break in color (from green to tannish-yellow or pink), mature green tomatoes are picked, packaged, and shipped before any color change has occurred. Mature green fruit is then ripened enroute to markets and in ripening rooms at destination. Packing at the mature green stage allows shipment to more distant markets than is possible for vine-ripe tomatoes.

Since the processing, packing, shipping, and wholesaling operations for these two types of tomatoes are substantially different, this report deals only with mature green tomatoes. A companion study deals with the packing procedures and costs for vine-ripes ([7]). [3]

The bulk of California's mature green tomato crop is grown in four regions. Production falls into three seasonal categories--early spring, early summer, and early fall. [4] Selected characteristics of the growing regions are given in table 1.

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[1] Agricultural economist, Commodity Economics Division, Economic Research Service, at University of California, Davis.
[2] Based on 1972 shipment data (see ([9])).
[3] Underscored numbers in parentheses refer to items in Literature Cited.
[4] These seasonal classifications are defined by the Statistical Reporting Service, U.S. Department of Agriculture (see ([10])). Early and late distinctions were dropped in 1973, and all fresh vegetable production is now classed in quarters; Winter (January-March), Spring (April-June), Summer (July-September), and Fall (October-December). California mature green tomatoes presently fall into the latter three seasons with a distinction between desert and other areas.

California production for the early spring season is largely accounted for by mature green tomatoes from the Imperial Valley. This is a short-season area, with most of the crop moving in June. Merced area production falls in the early summer season. The Merced District is also characterized by a relatively short season, shipping most volume in July.

The northern San Joaquin Valley and Gonzales-King City districts accounted for more than 70 percent of estimated 1972 mature green tomato shipments from the State. Both ship over a long period, with shipments classed in both the early summer and early fall seasons. Packinghouses in these districts commonly operate "split" seasons, shutting down during late August and early September when home-grown tomatoes and local supplies in major markets seasonally peak.

A general description of techniques used in packing mature green tomatoes and a specific description of a model packinghouse are presented in the following section. The model packinghouse used to synthesize mature green tomato packing costs is a fixed size plant with an hourly capacity of 30 tons of fruit dumped. This size is fairly typical of California operations based on field observations. While larger packinghouses are common, additional capacity is frequently attained by replication of equipment and techniques used in 30-tons-per-hour plants. Given this assumed size, costs for selected combinations of packing techniques and operating conditions are examined.

Table 1--Characteristics of districts producing mature green tomatoes in California

District number and name 1/	Counties included	Most active shipping period 2/	1972 shipments (carlot equiv.)	Estimated number of packing-houses
2--Imperial Valley	Imperial Riverside San Bernadino	June 1-June 30	1,030	8
5--Gonzales-King City	Monterey San Benito Santa Clara Santa Cruz San Mateo	July 15-Nov. 1	2,624	4
6--Merced	Merced Madera	July 1-July 31	1,319	6
7--Northern San Joaquin Valley	Stanislaus San Joaquin Sacramento	July 15-Nov. 1	3,117	10

1/ Numbers assigned by the California Fresh Market Tomato Advisory Board.

2/ Based on (10).

2

The sequence of operations performed in packing mature green tomatoes is illustrated in figure 1. Circles indicate operations, and arrows indicate the direction of product flow. Broken lines and circles indicate optional operations which are not performed in the model packinghouse considered in this study. Neither fruit procurement costs nor costs of repacking at destinations are considered in this report.

Fruit is brought from the field in two types of containers--bulk bins holding 800 to 1,200 pounds and bulk trucks or trailers. 5/ Upon arrival at the packinghouse, bins are forklifted to a conveyer leading to a hydraulic dumping table. In some cases, bins are placed in stacks of four on the conveyer and automatically destacked and restacked. Bulk carriers are tilt dumped into a dump basin filled with water, while bins may either be wet or dry dumped.

From the dumping station, the fruit is conveyed through a chlorine spray wash and dried with rubber donuts, frequently aided by fans blowing heated air over the top of the conveyer. Tomatoes then pass onto a belt presizer which removes sizes 7 x 8 and smaller. 6/ This undersized fruit is usually routed to the cull system, but may be retained and sold as pickling tomatoes. Waxing follows the presizing operation. Generally, this is accomplished by revolving brushes saturated by a wax emulsion.

Fruit is conveyed from the waxer to sorting tables for three distinct sorting operations--culling, color sorting, and grading. Generally, colored fruit is placed on an overhead conveyer and moved to a packing area for pinks; greens are segregated on opposite sides of the table; and culls are placed in a seperated center section of the table. Culls may also be removed at a pregrading table before waxing--the procedure assumed in this study.

Grades 1 and 2 of the mature greens are sized by belt or weight sizers. Sized fruit drops into belt conveyers where it is carried directly to packing chutes or to distribution belts which lead to packing chutes. Packing stations may be manual or automatic. In the case of manual stations, fruit in the packing chutes drops directly into boxes positioned under the chutes. Workers move empty boxes into position and remove full boxes to a take-away conveyer. The chutes may be equipped with foot-operated gates, which prevent fruit from dropping while a new box is being placed under the chute. Automatic stations employ a weight-sensing device to fill boxes. When a box is filled, a gate interrupting fruit flow is triggered, or the distribution belt is momentarily halted. The full box is ejected from the filling station and an empty box is moved into position.

5/ Wood field boxes holding 30 to 40 pounds of fruit were at one time the most common container for field-to-packinghouse transport. However, the use of field boxes is presently so rare that associated costs are not condisered in this report.

6/ Sizes used here and elsewhere refer to fruit configuration in the standard Los Angeles lug. For example, size 7 x 7 refers to tomato size such that 49 fruit fill a layer of the lug, arranged in 7 rows and colums.

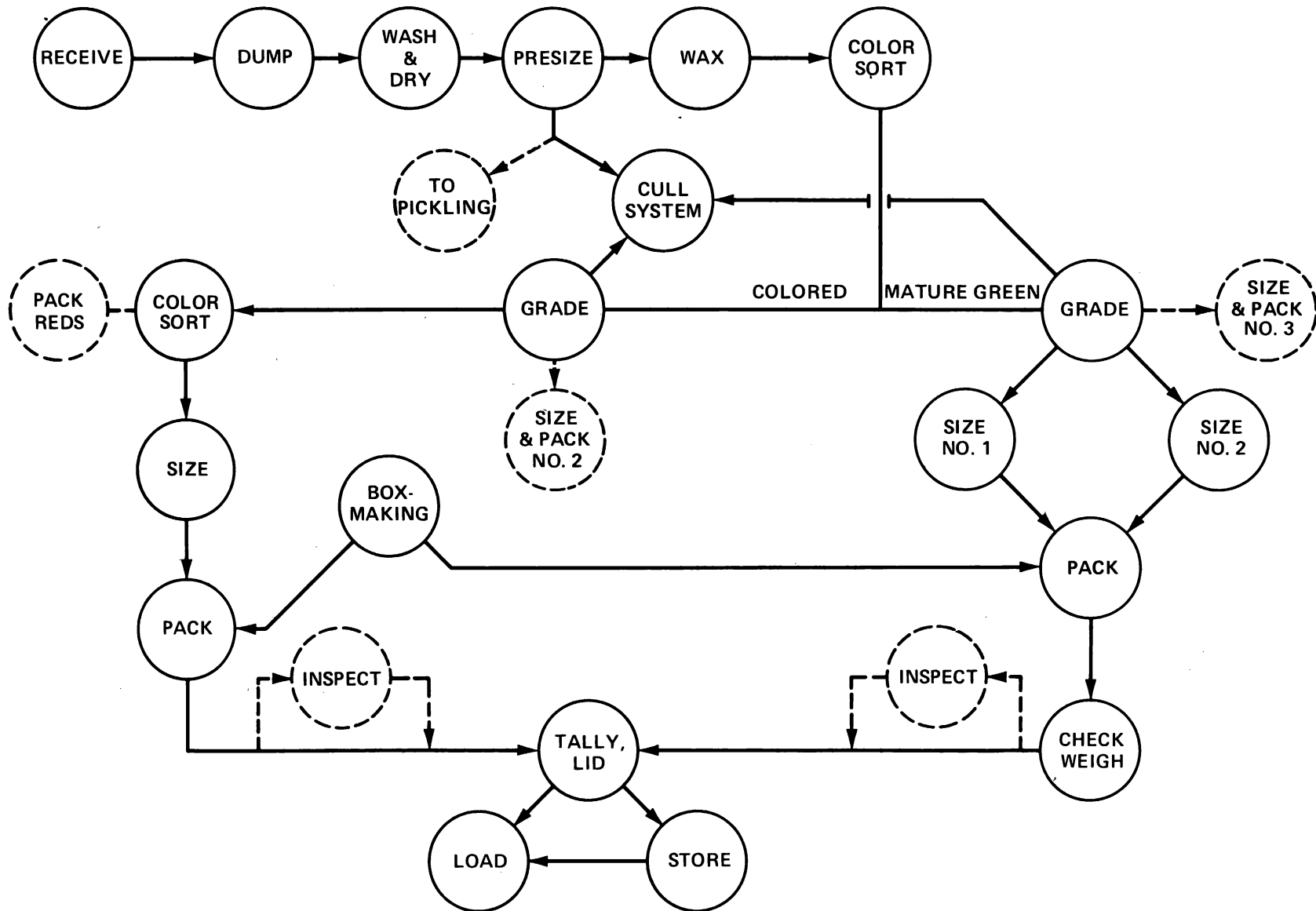# SEQUENCE OF OPERATIONS IN CALIFORNIA MATURE GREEN TOMATO PACKINGHOUSE

Figure 1

Packed boxes are carried by conveyer to a central location for check weighing and lidding. Workers position boxes on inline scales and remove or add fruit to bring the box weight to within tolerance. Lids are placed on the box bodies, and the boxes are manually removed from the conveyer and stacked or palletized. Hand trucks or forklifts are then used to convey the boxes to floor storage, cooling rooms, or gassing rooms. 7/ Pallets or boxes are subsequently transported to loading docks for either rail or truck shipment.

Colored tomatoes diverted from the green line are conveyed to a sorting table where they are hand separated by color, and, in some cases, by grade. Culls not removed in the initial sorting process are also removed at this point. Two to four colors are segregated on divided belts.

Sorted pinks are most commonly sized by belt sizers, but hand sizing and weight sizing are also used in some California mature green sheds. Both place packing and volume filling are used at the packing stage. When place packing is used, fruit usually drops directly into padded packing bins from the belt sizers. Volume-filling systems generally employ distribution belts and manual filling stations.

The cull removal network consists of cull conveyers from the sorting tables which feed into a main conveyer leading to an elevator outside the packinghouse. A holding bin is commonly employed to a temporarily store culls before removal to the field or landfills.

The most common type of container used for mature greens is a 30-pound-capacity corrugated box with double ends and bottom and a center divider. This type of container is either hand assembled or folded together by machine. Lids are of partial-telescope construction and are not fastened to the bodies. Like boxes, lids may either be hand or machine assembled. Boxes are usually assembled away from the main packing floor and carried to filling stations by monorail or roller conveyers.

The Model Packinghouse

A two-part survey was employed to define an appropriate-sized model mature green packinghouse and representative packing methods among those described above. The first part of the survey was a mail questionnaire which was sent to all known packinghouse operators in the summer of 1973. Selected indicators of size were requested in this questionnaire--total seasonal packout, season length, dump capacity per hour, total packing crew, and so forth. A high proportion of the responses indicated a maximum hourly capacity of around 30 tons of fruit dumped per hour. This size was consequently selected for the model packinghouse.

7/ The practice of using ethylene gas to promote ripening of California mature green tomatoes is increasing, but except for limited cases, gassing is done enroute to or at destination. Hence, costs associated with gassing at shipping point are not considered.

The second part of the survey involved interviews with packinghouse operators and observation of the houses during packing to determine representative methods. Substantial variability in some packing methods was apparent even among packinghouses with the same hourly capacity. On the other hand, methods used at other stages were practically identical among packinghouses. Based on the most common practices, methods were assigned to the model packinghouses for consideration (table 2). At four stages, pairs of methods are compared: half-ton bins and bulk trailers at the dump stage, belt and weight sizers for first-grade green sizing, manual and automatic fillers for first-grade greens, and place packing and volume filling (manual) for colored fruit.

A sample floor plan for the model mature green packinghouse is illustrated in figure 2. This plan shows trailer dumping, belt sizing, and automatic filling of No. 1 greens and place-packing facilities for vine-ripe fruit. The floor plan and equipment layout should be viewed as only one of many possible arrangements. In most California operations, packing lines are designed to fit existing buildings. Consequently, a good deal of variability in layouts is observed.

Model Packinghouse Operating Conditions

Several assumptions concerning operating practices are imposed on the model packinghouse in order to derive seasonal average costs. In most cases, these are based on observed industry practices and conditions, averaged over a season where necessary. Some of the more important of these assumptions are discussed below. Others are defined where encountered in the presentation of costs.

1. Grades and colors packed. Two grades of mature greens are packed in the model packinghouses. The first is equivalent to 85 percent U.S. No 1, while the second grade corresponds to U.S. No. 2. However, none of the output is USDA inspect ed. 8/ A single grade of vine-ripes is packed and divided into two color classes. The USDA color definitions "breakers" and "#1 turning" are packed as one color, and "#2 turning" and "pink" as the second. Sizes packed for both greens and vine-ripes include 7 x 7 and larger. The exact sizes packed will vary during the season, but no more than four sizes are separated at any time for both types of fruit.

8/ Use of continuous USDA inspection is increasing in California mature green packinghouses, but the practice is not universal. Output is stipulated as meeting USDA when inspection is not used. Inspection is mandatory for exports to Canada. Since inspection charges are uniform rates per container, they can easily be added to the per box costs estimated for the model packinghouse.

FLOOR PLAN, MODEL CALIFORNIA MATURE GREEN TOMATO PACKINGHOUSE

BOX ASSEMBLY
AND STORAGE
(30-POUND CARTONS)

PACK NO. 1

OFFICE

MONORAIL BOX
CONVEYER

SIZE
AND
PACK
NO. 2

WASH, PRE-
DRY GRADE

WAX

SORT
(COLOR AND GRADE)

SIZE
NO.1

NO. 2

SIZE
NO.1

DUMP
TABLE
(TRAILERS)

PRE-
SIZE

COLORED

FLAT AND LUG
ASSEMBLY AND
STORAGE

DUMP
TANK

MONORAIL BOX
CONVEYER

CULL AND
SEPARATE
COLORS

CHECK WEIGH

LID

RESTROOMS

CULL
BIN

SIZE AND PACK COLORS

TRUCK
LOADING

NOT TO SCALE

COLD STORAGE

CAR LOADING
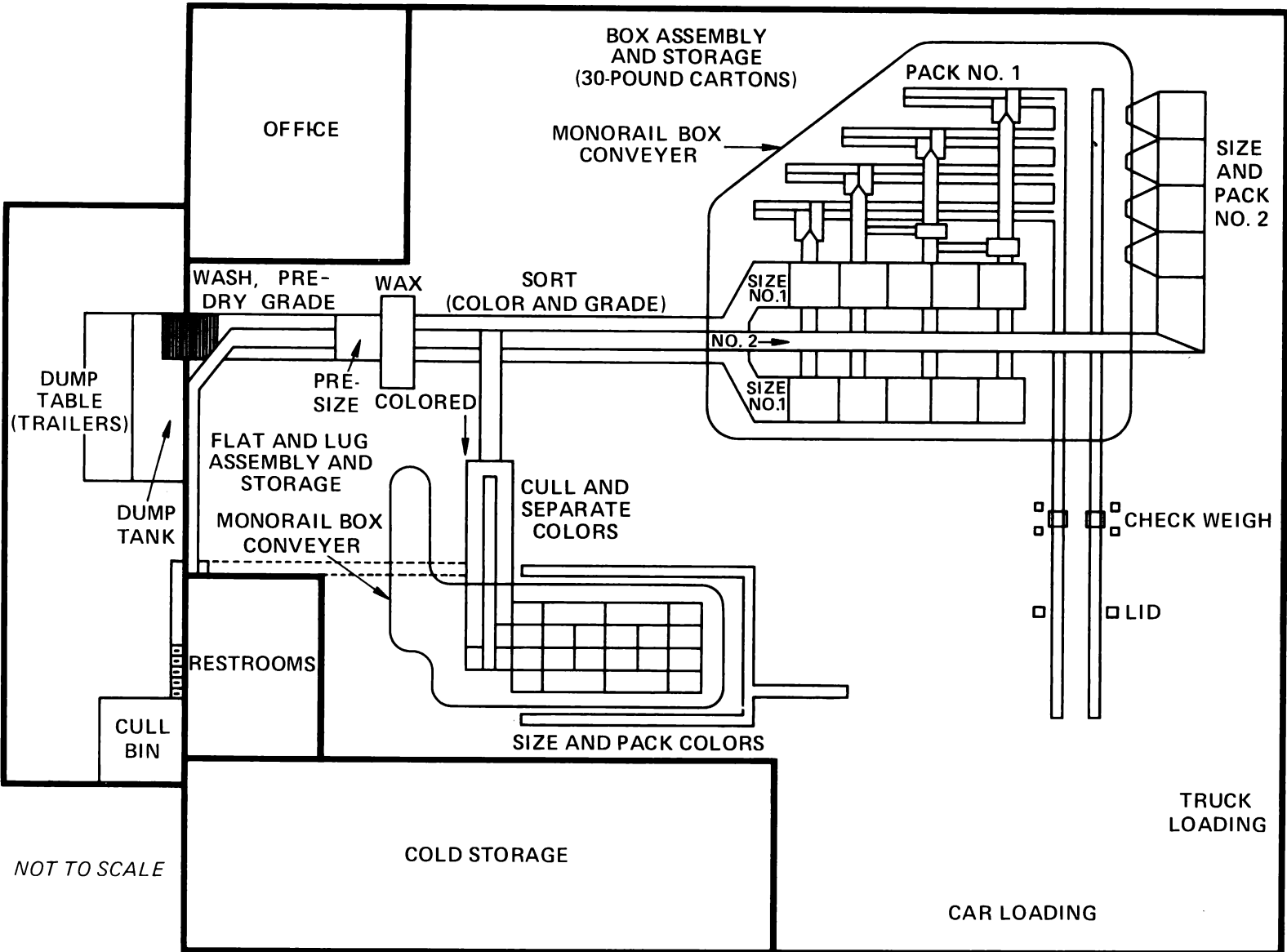
Figure 2

Table 2--Packing techniques used in model mature green tomato packinghouse

Stage	Method
Field-to-plant handling and dumping	Alternative 1: Bulk bins (1,000-pound capacity) unloaded from truck and placed on conveyer by forklift. Dry dumped using hydraulic dump table.
	Alternative 2: Bulk trailers (8,000-pound capacity) pulled across tilt-table and dumped into chlorinated water.
Wash, dry, and wax	Chlorinated water spray wash, foam-rubber donut drying plus heated air drying, and emulsion wax-brush waxing of both greens and colored.
Presize and sort	Belt presizing of 7 x 8 and smaller. Under-sized fruit removed to cull system. Hand inspection and segregation of culls, all colored, first grade, and second grade.
Size greens	Alternative 1: Perforated belt.
	Alternative 2: Weight activated.
Pack greens	Alternative 1: Manual volume filling.
	Alternative 2: Automatic volume filling
Sort pinks	Hand sorting, 2 colors.
Size pinks	Perforated belt, 4 sizes.
Pack pinks	Alternative 1: Place packing in flats and lugs.
	Alternative 2: Manual volume filling.
Filled-container handling ...	Palletized, forklift handling.
Boxmaking	30-pound corrugated boxes, machine-constructed; lugs and flats assembled by hand in packinghouse.
Empty-container distribution	Monorail.
Cull removal	Cull belts distributing to central collection belt to cull elevator to bin to dump truck.

The most common sizes packed would be 7 x 7, 5 x 7, 6 x 6, and 5 x 6 and larger. 9/

2. Distribution of pack. Total tonnage received at the packing-house is assumed to be distributed in the following manner: 15 percent culls, 15 percent colored (vine-ripes), 50 percent No. 1 greens, and 20 percent No. 2 greens. These percentages exhibit large seasonal variability in real-life conditions due to fruit-ripening patterns and changing weather. 10/

3. Containers. All mature green output is packed in 30-pound net weight corrugated containers. The same container is used for vine-ripes when volume filling is used. When vine-ripes are place packed, two-and three-layer L.A. flats and lugs are used with a 75-percent flat, and a 25-percent lug distribution, averaging 25 pounds net weight per container (see (7)).

4. Seasonal capacity. The model packinghouse achieves 70 percent of potential capacity during the season, regardless of season length. A full crew is employed during all operating hours, and 15 percent of total time is assumed to be overtime for the purpose of calculating employee compensation. 11/

9/ New tomato sizing standards were put into effect in December 1973, with size designations that do not correspond exactly with the Los Angeles lug numerical designations. Since this study was completed prior to adoption of the new standards, old designations are retained. For reference purposes, the approximate correspondence between the old and new standards is:

Tomato size designations

Old	New
8 x 8	minimum small
7 x 8	extra small
7 x 7	small
6 x 7	meduim
6 x 6	large
5 x 6, 5 x 5	extra large
4 x 5	maximum large

10/ Most mature green packinghouses attempt to minimize the percentage of vine-ripes in the incoming fruit supply. However, some alter the mature green vine-ripe mix according to market conditions. The model packinghouse defined here is assumed to minimize the proportion of vine-ripes packed.

11/ This operating pattern differs from those assumed for model vine-ripe packinghouses, where partial crews were employed during parts of the season and no overtime was incurred ((7)). This difference stems mainly from the greater incidence of employee unionization in mature green packinghouses.

INVESTMENT AND OPERATING COSTS

Investment requirements and costs of operating the model packinghouses were derived from both primary and secondary sources of information. Several comparable studies based on conditions in other States provided much of the needed data on physical plant requirements and labor standards. These included Bohall, Farrish, and Podany (1), Brooker and Pearson (2, 3), Grizzel (6), and Meyer (8). Construction cost data were obtained from commercial construction companies and published construction cost guides (5). Equipment specifications and prices were provided by manufacturers, who also indicated standard installation procedures and costs. Specifications, costs, and standards obtained from these sources were checked with packinghouse managers who verified or recommended adjustments to individual components.

Land and Buildings

Land and building specifications and costs are summarized in table 3. About 6 acres of land are indicated, representing a total investment of $27,500, including site preparation and utility connections. Annual ownership cost is $2,475, or 9 percent of initial land investment. This includes 8 percent as interest on investment and 1 percent for taxes.

Building investment totals $125,450, and annual ownership costs for buildings are $14, 300, or 11.4 percent of initial investment. Individual components of annual ownership costs for buildings are as follows:

	Annual percentage	
Depreciation	4.0	(Straight-line depreciation on 25-year life)
Interest on investment	4.0	(8 on 1/2 estimated construction cost)
Repairs	1.8	
Taxes	1.0	
Insurance	0.6	
Total	11.4	

The fixed charges for repairs, taxes, and insurance are approximations based on (1) and verified by packinghouse managers.

Table 3--Land and building requirements, model California mature
green tomato packinghouse

Area	Square feet required	Cost per square feet	Total investment	Annual ownership cost 1/
		- - - - Dollars - - - - - - - -		
Land & site preparation 2/	250,000	.11	27,500	2,475.00
Buildings:				
Receiving deck	1,300	2.30	2,990	340.86
Loading docks	1,000	5.20	5,200	592.80
Restrooms	300	15.40	4,620	526.68
Office	720	7.00	5,040	574.56
Cold storage room	2,500	17.00	42,500	4,845.00
Packing and storage area	10,500	6.20	65,100	7,421.40
Total buildings	16,320		125,450	14,301.30
Total investment and annual fixed cost, land and buildings			152,950	16,776.30

1/ Annual depreciation, interest on investment, repairs, taxes, and insurance
per schedule in text.
2/ Includes grading and water and sewer connections.

Equipment

Model packinghouse equipment specifications are given in appendix table 1.
Prices are based on quotes provided by equipment suppliers. The stationary
equipment prices were increased by 17.5 percent to cover installation and
shakedown.

Table 4 shows equipment costs by initial investment, hourly operating costs,
and annual ownership costs for each of the alternative packing methods consid-
ered. Hourly operating costs are calculated as 3 cents per motor horsepower
plus .005 percent of replacement costs for repairs (1). An additional repair
charge of 1.5 percent of installed cost is included in ownership costs to cover
maintenance and part replacement costs not directly connected with hourly usage.
Other annual ownership costs include depreciation (based on straight-line method
and life shown in appendix table 1), insurance and taxes at 2 percent of replace-
ment cost, and 4-percent interest on investment (based on 8-percent opportunity
interest rate). Annual ownership costs total 2.5 percent of replacement cost
plus depreciation.

Table 4 illustrates substantial differences in equipment costs for those
stages where alternative methods are considered. The most notable difference
is at the dump stage, where initial investment in trailer dumping equipment is
shown to be double that for bin dumping. Since trailers have a useful life of

Table 4 --Equipment investment, variable costs, and fixed costs by stage,
model California mature green tomato packinghouse

Stage	Initial investment	Variable costs per hour	Annual ownership cost
		Dollars	
Dump:			
Bins ., ...	52,932	6.83	12,863.10
Trailers	111,625	9.53	16,131.38
Wash, dry, and wax	1/		
Sort and grade	18,682	1.19	3,269.44
Size No. 1 greens:			
Belt size	10,575	.62	1,850.62
Weight size	15,628	.84	2,724.81
Pack No. 1 greens:			
Manual fillers	11,754	.71	2,056.95
Automatic fillers	19,973	1.15	3,495.27
Size and pack No. 2 greens	5,288	.31	925.40
Sort, size, and pack colored fruit:			
Place packing	16,682	.95	2,919.35
Volume filling	12,920	.72	2,261.00
Filled-container handling..	7,745	.56	1,477.93
Boxmaking and distribution.	9,956	.75	1,742.30
Cull removal	12,615	1.22	2,207.63
Nonspecific 2/	5,000	.25	875.00

1/ Equipment leased.

2/ Office furniture, machines, and equipment and miscellaneous packinghouse equipment.

Source: Appendix table 1.

15 years compared with a 5-year life for bins, the difference in annual owner-ship costs is less dramatic, although bins still exhibit a cost advantage of more than $3,000 per year.

Depending upon methods used, total equipment investment ranges from $147,467 to $223,194, and annual ownership costs range from $29,528 to $35,777. Lowest investment and annual ownership costs are associated with bin dumping, belt sizing, and automatic filling of No. 1 greens and volume filling vine-ripes.

Other Fixed Costs

A major component of fixed costs for the packinghouse operation is salary expense (table 5). Assigning salaried employees for the model is difficult because some employee time is contingent on season length, which varies substantially among California mature green producing regions. Therefore, it was necessary to assume a 4-month season to derive salary cost, even though this is longer than the operating season of many packinghouses. However, this does not seem to be a severe assumption, for even in short-season districts, salaried personnel would be required for periods longer than the actual packing season.

Table 5--Salaried labor, model California mature green tomato packinghouse

Job description	Months required	Monthly salary 1/	Seasonal salary expense
		- - - - Dollars - - - -	
General manager	12	1,250	15,000
Fieldman	12	850	5,100 2/
Foreman	4	1,000	4,000
Floor person	4	775	3,100
Mechanic	6	850	5,100
Sales manager	4	500 3/	2,000
Secretarial-clerical:			
Permanent	12	600	7,200
Temporary	8	500	4,000
Total salary expense			45,500

1/ Includes fringe benefits.
2/ One-half of fieldman's salary charged to growing operation, and one-half to packing.
3/ Sales manager is also paid a fee per box which is included in variable costs.

For the model, three salaried employees--a general manager, a fieldman, and one secretary--are required for a full year. A mechanic is employed for 6 months, and other salaried labor is retained for 4-month periods. Total salary expense is $45,500.

Miscellaneous fixed costs for the model mature geeen packinghouse total $6,000 annually. Specific components of miscellaneous fixed costs are indicated in table 6.

Table 6--Miscellaneous fixed costs, model California
mature green tomato packinghouse

Item	:	Cost per season
	:	Dollars
Office supplies	:	2,000
Legal & accounting fees	:	1,000
Dues & subscriptions	:	1,000
Telephone (fixed) 1/	:	500
Other 2/	:	1,500
Total	:	6,000

1/ An additional telephone charge, varying with packout, is included in variable costs.
2/ Donations, miscellaneous supplies, and expenses.

Variable Operating Costs

There are two types of variable costs associated with the packinghouse operation--those which depend on the number of hours operated and those which depend on the number of containers packed. The major component of the first type is wages, while container costs are the major part of the second.

Job descriptions by stage, assumed performance standards, and hourly wage scales are given in appendix table 2. Performance standards are based on actual packinghouse observations augmented by information obtained in an earlier report (3). Wages are 1973 union scale plus 17.5 percent for fringe benefits. 12/

Crew requirements and wage costs per hour by packing stage are summarized in table 7. Total crew requirements range from 97 to 116 employees, depending on the particular set of packing methods employed. The comparable range in hourly wage cost is $280.67 to $329.24, or $.236 to $.277 on a 30-pound equivalent container basis at 70 percent of capacity.

12/ Amalgamated Meat Cutters and Butchers Workmen of North America, AFL-CIO, Packing House Agreement--Tomatoes. The contract covers Contra Costa, Sacramento, San Joaquin, Solano, and Stanislaus counties.

Table 7--Crew requirement and hourly labor cost by stage, model California mature green tomato packinghouse

Stage	Crew requirement	Labor cost per hour 1/
		- - Dollars - -
Dump:		
Full bins	3	10.74
Trailer	3·	9.99
Sort:		
Pregrade (culls only).............	12	35.86
Color separation (from greens) ...	10	29.89
Grade	20	59.77
Color sort (on vine-ripe line) ...	4	11.95
Total	46	137.47
Pack greens:		
Manual fill No. 1	12	38.40
Automatic fill No. 1	5	16.69
Pack vine-ripes:		
Place pack	12	2/
Volume fill all fruit	4	13.16
Tally, check weigh, and lid:		
Place pack vine-ripes	10	30.77
Volume fill all fruit	11	33.73
Store and load ·....................	13	36.47
Box assembly and distribution:		
Place pack vine-ripes	15	47.40
Volume fill all fruit ....,...	12	37.41
Miscellaneous and unclassified	4	11.87
Range in total crew requirement 3/..	98-115	
Range in hourly labor cost: 3/		
Total		280.67-329.24
Per 30-pound equivalent 4/		.236 - .277

1/ Hourly rate from app. table 2 adjusted to reflect 15 percent overtime at time and a half.

2/ Packers paid on a piece-rate basis when place packing is used. Piece rate ($.0825 per layer) included in variable costs per container.

3/ Minimum and maximum values are contingent on techniques employed.

4/ At 70 percent of potential capacity (1,190 30-pound equivalents per hour).

Source: App. table 2.

Table 8--Operating costs, model California mature green tomato packinghouse

Item	Cost per hour	Cost per container Flats and lugs	Cost per container 30-pound cartons
	Dol.	- - Cents - -	
Costs constant with each hour of operation:			
Utilities:			
Electricity 1/	4.89		
Other	6.50		
Forklift rental 2/	5.30		
Total	16.69		
Costs constant with each unit of packout:			
Containers		43.32	45.00
Pallets (disposable)		3.33	3.33
Washing-waxing equipment, lease and supplies		4.00	4.00
Packing labor 3/		18.57	
Marketing order assessment & Western Grower Association dues		.45	.56
Selling cost 4/		5.50	5.50
Total		75.17	58.39

1/ Does not include electricity for machine operation.

2/ Based on monthly lease charge of $380 per month for 200 hours use plus $1.50 per hour for fuel. Includes 2 forklifts for container handling only.

3/ Assumes 75/25 flat/lug distribution.

4/ Broken down approximately as follows: 2 cents for sales commission, 1 cent for telephone charge, 0.2 cent for advertising, and 2.3 cents for breakage, damages, and other selling costs.

The alternative methods considered at the dumping stage utilize the same number of workers. However, hourly labor cost for trailer dumping is slightly lower because less skilled workers are needed. Automatic filling of No. 1 greens uses seven fewer workers than manual filling. Place packing of vine-ripes requires eight more workers than volume filling at the filling stage, plus three additional workers at the box assembly stage, but one less worker at the tallying, checkweighing, and lidding points, resulting in a net difference of 10 workers.

Note that labor costs in table 7 reflect hourly wages in appendix table 2 plus overtime payment at the rate of one and one-half times 15 percent of total time. In other words, gross hourly wages are calculated at .85 x (hourly wage) + .15 x (hourly wage x 1.5).

Other variable costs are summarized in table 8 according to hours worked or containers packed. In addition to labor and hourly machine operation cost, other variable costs per hour include utilities and forklift rental. 13/ Electricity costs are for lighting (1 kilowatt per 100 feet of floor space), refrigeration, and miscellaneous electrical equipment. Other utilities include water and sewer. Two forklifts are required at a rental cost of $380 per month for 200 hours use plus $1.50 per hour for gas.

Several costs by containers packed are shown in table 8. Container costs-- an average of manufacturers' quotes--are given for both flats and lugs (when place packing is used) and 30-pound cartons. The 30-pound carton is of corrugated construction with a partial-telescope lid and reinforcing center divider. Given the seasonal volume of the model packinghouse, the cost specified includes labeling and provision of box- and lid-making equipment by the supplier. The flat and lug container costs reflect a hand-assembled corrugated unit purchased in lots of 5,000 (7). A 75-percent flat, 25-percent lug distribution is assumed.

All model packinghouse output is assumed to be shipped on pallets, which add 3-1/3 cents to costs per container. Equipment for washing, drying and waxing fruit is leased on a per packed container basis. Equipment lease plus supplies (chlorine and wax) is 5 cents per container for the model. Packing labor cost, applicable only where place packing of vine-ripes is used, is based on a piece-rate scale of 8.25 cents per layer. The marketing order assessment of 2.5 cents per hundredweight is assumed to be shared equally by growers and packers, while the Growers Association dues are paid by the packinghouse. Selling costs totaling 5-1/2 cents per container are comprised of several components, including selling commission, telephone charges, advertising, and miscellaneous.

13/ Leased forklifts are used for filled-container handling. Forklifts used for bin handling when bin dumping is used are owned. Leasing in the latter case is not advantageous because the forklifts are used for bin handling for lengthy periods before and after the season.

The three types of costs defined earlier--annual fixed costs, costs per hour, and costs per container packed--are summarized in table 9. The base column in the table heading refers to bin dumping, belt sizing of No. 1 greens, manual volume filling of No. 1 greens, and place packing of vine-ripes. The next four columns of the table reflect costs for the four alternative methods, where only the method used at the applicable stage is different from the base-- that is, the "trailer dump" column lists costs when trailer dumping is used instead of bin dumping and all other packing methods are the same as used in the base combination of methods. 14/ The columns "minimum cost" and "maximum cost" are discussed later.

Given the assumption that the model packinghouse achieves 70 percent of potential seasonal capacity, total season and unit costs are derived by specifying season length. Initially, to allow consistent comparisons, a "unit" is defined as a packable hundredweight. The specific formula for calcualting total seasonal packing cost is:

Total cost = Annual fixed costs + (hours operated x costs per hour)
        + (containers packed x costs per container)

Unit cost is defined simply as total cost divided by seasonal packout in hundredweight.

Given the model packinghouse achieves 70 percent of maximum capacity over the season, seasonal packout in the formula above is directly related to hours operated and the culling rate. With the assumed 15-percent cull rate, seasonal output in hundredweight is (.85 x (.70 x 60,000 pounds) x hours operated) ÷ 100. Here, 60,000 pounds is the maximum hourly input, 0.85 is the proportion of usable fruit, and 0.70 is the proportion of maximum capacity achieved over the season. Using a 400-hour season as an illustration, the model packinghouse would receive 8,400 tons of field-run fruit of which 7,140 are packable. Total seasonal output of the model is 142,800 hundredweight--280,000 30-pound cartons of No. 1 mature greens, 112,000 cartons of No. 2 mature greens, and 84,000 30-pound cartons of vine-ripe fruit if volume filling is used or 75,600 flats and 25,700 lugs if place packing is used.

Comparison of Alternative Packing Methods

There is a fixed relationship between hours operated and seasonal packout due to the model packinghouse operating conditions. Specifically, average hourly output of packable fruit is 357 hundredweight (600 hundredweight received x 0.85 x 0.70). This relationship indicates unit costs are directly related to season length. Based on the cost components in table 9, unit costs in dollars

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14/ The methods considered are "stage independent". That is, if at any stage, method A demonstrates lower costs than method B, it will do so regardless of what methods are employed at other stages. Furthermore, the difference in unit costs between the high- and low-cost methods of any stage will be identical regardless of the methods considered at other stages.

Table 9--Summary of packing costs for alternative packing techniques, model California mature green tomato packinghouse

Cost component	Table reference	Packing method						
		Base 1/	Trailer dump	Weight sizing	Automatic volume fill #1 greens	Volume fill vine-ripes	Minimum cost 2/	Maximum cost 3/
		- - - - - - - - - - - - - - Dollars per season - - - - - - - - - - - - - -						
Fixed costs:								
Land and buildings	3	16,766.30	16,776.30	16,776.30	16,776.30	16,776.30	16,776.30	16,776.30
Equipment	4	30,187.72	33,456.00	31,071.91	31,626.04	29,529.37	30,967.69	34,340.19
Salaried employees	5	45,500.00	45,500.0	45,500.00	45,500.00	45,500.00	45,500.00	45,500.00
Miscellaneous fixed costs ..	6	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Total		98,464.02	101,732.30	99,348.21	99,902.34	97,805.67	99,243.99	102,616.49
		Dollars per hour						
Variable costs per hour:								
Labor	6	313.12	312.47	313.12	291.41	319.25	297.54	315.37
Equipment	4	13.39	16.09	13.61	13.83	13.16	13.60	16.08
Miscellaneous	8	16.69	16.69	16.69	16.69	16.69	16.69	16.69
Total		343.20	345.25	343.42	321.93	349.10	327.83	348.14

Cost component	Table reference	Dollars per container	
		Flats and lugs 4/	30# cartons
Variable costs per container:			
Packing labor	8	.1857	--
Containers	8	.4332	.4500
Other	8	.1328	.1339
Total	8	.7517	.5839

-- = Not applicable.

1/ "Base" packing method is bin dumping, belt sizing of No. 1 greens, manual volume filling of No. 1 greens, and place packing vine-ripes. Each of the other alternatives listed represent changes from the base only in the applicable stage.

2/ Combination of techniques yielding lowest unit costs (per hundredweight) for seasons exceeding 100 hours.

3/ Combination of techniques yielding highest unit costs (per hundredweight) for seasons exceeding 100 hours.

4/ Net weight of flats is 23 pounds, and lugs, 31 pounds. A 75-percent flat, 25-percent lug distribution is assumed.

per hundredweight for the base combination can be expressed as:

$$\frac{\$275.81}{\text{Hours Operated}} + \$3.0947$$

In this formulation, $275.81 is annual fixed cost (98,464.02) divided by 357, hourly packout in hundredweight. The second cost component, $3.0947, is variable costs per hour ($343.20) plus variable costs per container ($0.7517 x 252 and $0.5839 x 980) 15/ expressed on a per packable hundredweight basis. The applicable cost formulas for the alternative methods are:

Trailer dump: $\quad\dfrac{\$284.96}{\text{Hours Operated}} + \$3.1005$

Weight sizing: $\quad\dfrac{\$278.29}{\text{Hours Operated}} + \$3.0954$

Automatic volume fill
#1 greens: $\quad\dfrac{\$279.84}{\text{Hours Operated}} + \$3.0351$

Volume fill vine-ripes: $\quad\dfrac{\$273.97}{\text{Hours Operated}} + \$2.9241$

Based on these cost formulas, differences in unit costs between the alternative packing methods are related to season length in the manner indicated in figure 3. The plotted data indicate the difference in unit costs between the high-cost and low-cost methods at each of the stages where alternatives are considered.

Place packing of vine-ripe fruit in the mature green model packinghouse is a particularly high-cost handling method relative to volume filling. This is due to the high cost of packing labor and the larger equipment investment required for place packing. At 400 hours, the difference in cost between place packing and volume filling would be 17-1/2 cents per hundredweight of packable fruit. 16/ Translated to a seasonal basis under the assumed model operating conditions, the difference in cost would be about $25,000. This means that for place packing to be economically feasible in the model mature green packinghouse place-packed tomatoes must yield a price premium of $1.00 per hundredweight, or 1 cent per pound. Consequently, the degree of customer acceptance of volume-filled vine-ripes and market potential are vital considerations in determining which packing technique to employ.

The difference in unit costs between bin and trailer dumping is significantly smaller and largely attributable to the high initial investment required

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15/ Hourly packout consists of 252 25-pound flats and lugs and 980 30-pound cartons when place packing is employed. When all fruit is volume filled, packout is 1,190 30-pound cartons.

16/ This includes all tomatoes packed, both mature green and vine-ripes.

DIFFERENCES IN UNIT PACKING COSTS, ALTERNATIVE METHODS, CALIFORNIA MATURE GREEN PACKINGHOUSE

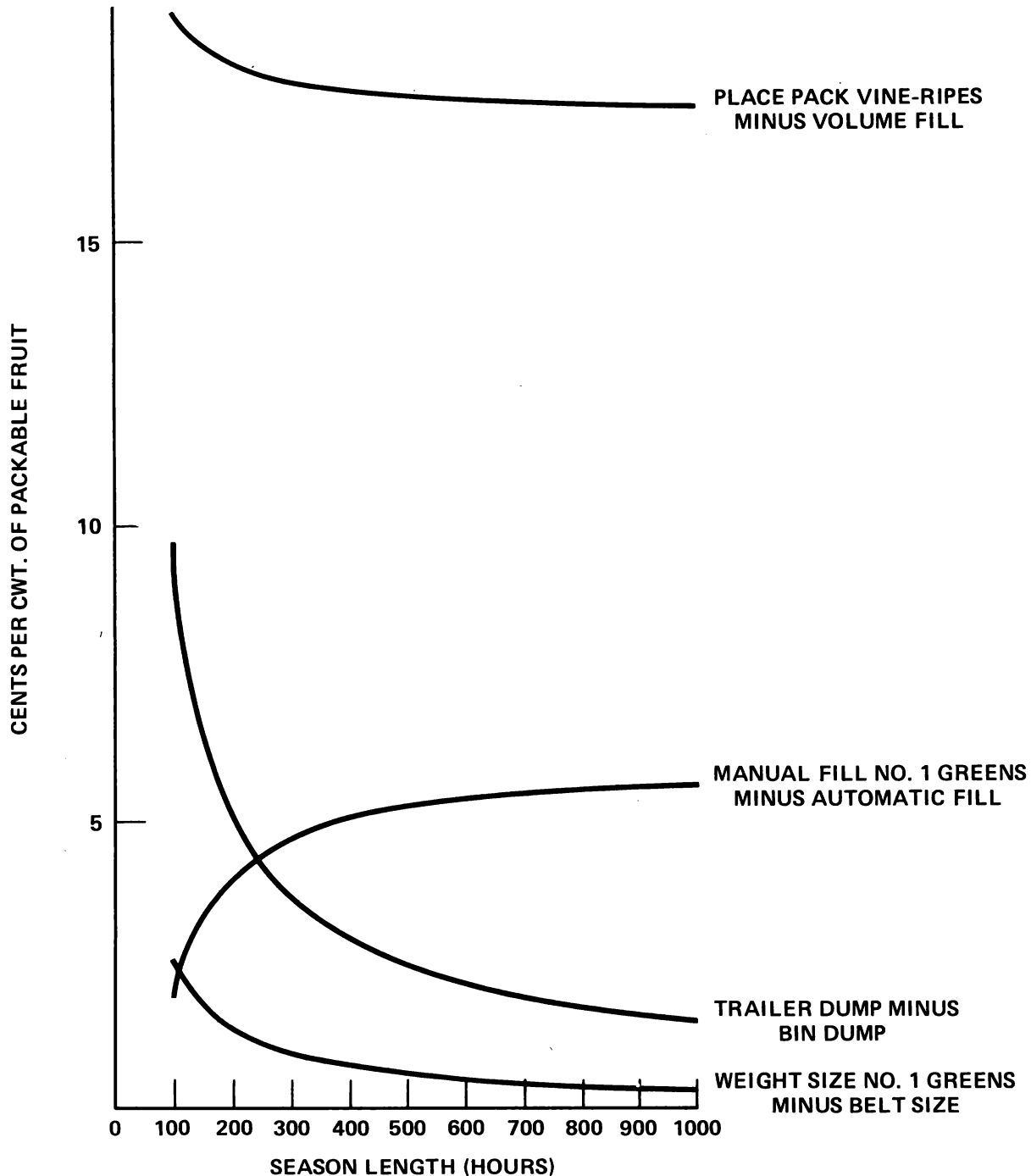Figure 3

for trailers and the resulting high annual fixed charge for this method. 17/ Operating the model packinghouse at 400 hours per season gives a per hundred-weight cost advantage to bin dumping of about 3 cents, or a seasonal total difference in costs of $4,100. However, since this analysis does not consider tomato handling steps prior to dumping at the packinghouse, it is possible that the use of trailers at the picking and loading stage would yield cost savings which exceed this small cost disadvantage at the packinghouse. Careful consideration would be given to this possibility prior to a decision to adopt either dumping method.

Belt sizing of No. 1 greens shows a very small cost advantage over weight sizing in the model packinghouse--less than 1 cent per hundredweight of packable fruit at 400 hours, or about $1,000 per year. This was due solely to the higher initial cost of weight-sizing equipment. The very small difference in costs suggests that the choice of what type of sizer to employ is more dependent on differences in performance and the incidence of mechanical damage than on owner-ship and operating costs.

For the practical range of season lengths, use of automatic fillers for No. 1 mature greens yields lower unit costs than manual filling. 18/ While the initial investment for automatic filling equipment is greater, hourly variable costs are substantially less. Hence, at a marginal annual ownership cost of $1,600, seven fewer employees are required.

The column headed "minimum cost" in table 9 outlines annual fixed and variable charges for the model packinghouse using the lower cost methods at stages where alternatives are considered. The "maximum cost" column similarly denotes higher cost methods. Under the model operating assumptions, the minimum cost combination yields unit costs for a 400-hour season of $3.56 per hundred-weight of packable fruit, compared with $3.82 for the maximum cost combination. This reflects a difference in total costs per season of $37,000.

Unit Costs by Packing Stage

Given the minimum cost combination of packing methods for the model, it is useful to break down unit packing costs to examine the relative contribution of each stage to total unit costs. This is done in table 10, where units are re-defined as 30-pound cartons, the common container for all fruit packed. 19/ Costs reflect the assumed model packinghouse operating conditions for a 400-hour season.

17/ It should be noted that trailers could be leased to reduce the required investment. In the case of short seasons, this policy could also reduce fixed annual costs for trailer dumping. But in general, ownership of trailers is the less costly alternative, and leasing is not considered here.

18/ The critical season length is 67.5 hours. Above this level, automatic filling results in lower costs than manual filling.

19/ Thirty-pound equivalents were not meaningful units when discussing packout composed of both 30-pound boxes and 25-pound flats and lugs.

Table 10--Packing cost per 30-pound carton by stage, model California mature green tomato packinghouse, 400-hour season 1/

Stage	Annual fixed costs	Variable costs		Total	Percent of all costs
		Constant per hour of operation	Constant per carton packed		
	- - - - - Cents per carton - - - - -				Percent
Dump	2.70	1.47	--	4.17	3.9
Wash, dry, and wax ...	--	--	4.00	4.00	3.8
Sort	.69	11 65	--	12.34	11.6
Size greens	.39	.05	--	.44	.4
Pack greens	.93	1.53	--	2.46	2.3
Sort, size, and pack vine-ripes	.48	1.16	--	1.64	1.5
Filled-container handling	.31	6.39	3.33	10.03	9.4
Boxmaking and distribution	.37	3.20	45.00	48.57	45.5
Cull removal	.46	.10	--	.56	.5
Nonspecific 2/	14.53	1.97	6.06	22.56	21.1
Total	20.86	27.52	58.39	106.77	100.0
Percent of total cost	19.5	25.8	54.7	100.0	

-- = Not applicable.

1/ Using least-cost combination of packing methods.

2/ Costs which cannot reasonably be assigned to a particular stage. Include land and buildings, miscellaneous fixed costs, salaried labor, utilities, selling costs, and association dues.

Total unit costs of $1.07 per carton are comprised of 19.5-percent fixed charges, 26-percent variable costs constant per hour of operation, and 54.5-percent variable costs constant per container packed. The most costly stage is box makeup and distribution, which includes container expense. This stage accounts for nearly half of total unit costs at this level of output (476,000 cartons per season). Furthermore, carton costs relative to total unit costs increase as season length is extended.

Costs not directly related to any particular stage are the second largest component of total unit costs, contributing 21 percent. These costs are largely annual fixed costs associated with land and buildings, salaried labor, and miscellaneous expenses invariable with packout or season length. Other relatively expensive stages are sorting and filled-container handling, comprising 11.5 and 9.5 percent of total unit costs, respectively. Costs at these stages are mainly labor charges.

Costs Under Alternative Operating Conditions

Up to this point, costs for the model packinghouse have been discussed, assuming a specific set of operating conditions. The effect of altering some of these conditions is illustrated in figure 4, which indicates how unit costs for the model are influenced by season length, culling rate, and how close to maximum capacity the packinghouse operates. In all cases, the least-cost combination of packing methods is used. Note that all three of these variables are directly related to seasonal packout, and consequently, so are unit fixed costs and costs constant per hour of operation on a per container basis. Variable costs constant per container packed are 58.4 cents, irrespective of packout (see table 9), [20] but these costs as a proportion of total unit costs increase with packout.

Unit packing costs drop sharply when season length is extended from 100 hours but demonstrate little change beyond 600 hours (fig. 4A). The change from 100 to 400 hours is more than 60 cents per 30-pound carton, while from 400 to 1,000 hours, unit costs drop only about 12 cents. Hence, the economic incentive to expand operating time to some minimum level is well illustrated. In recent years, some California mature green tomato packers have transported fruit long distances from early maturity regions in order to begin packing before local acreage is ready to harvest. Figure 4A suggests that large transportation costs incurred in these cases could well be offset by a reduction in seasonal average unit packing costs resulting from the season extension.

The effect of culling percentages from 0 to 50 percent on unit packing costs is shown in figure 4B. Season length is set at 400 hours at 70 percent of capacity in this case. Costs rise from just under $1.00 for no culls (a highly unrealistic situation) to $1.07 for 15 percent culls. Beyond 15 percent, a more rapid rise in costs is experienced--a 10-cent increase from 15 to 30 percent and 16 cents from 30 to 45 percent. Over a normal season, culling percentages in most California mature green packinghouses average below 20 percent, indicating that little cost savings could be gained by attempts to reduce the cull rate. On the other hand, this analysis considers only costs of packinghouse

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[20] Unit costs when all output is packed in 30-pound cartons.

EFFECT OF OPERATING
CONDITIONS ON PACKING COSTS,
MODEL CALIFORNIA
MATURE GREEN PACKINGHOUSE

Figure 4

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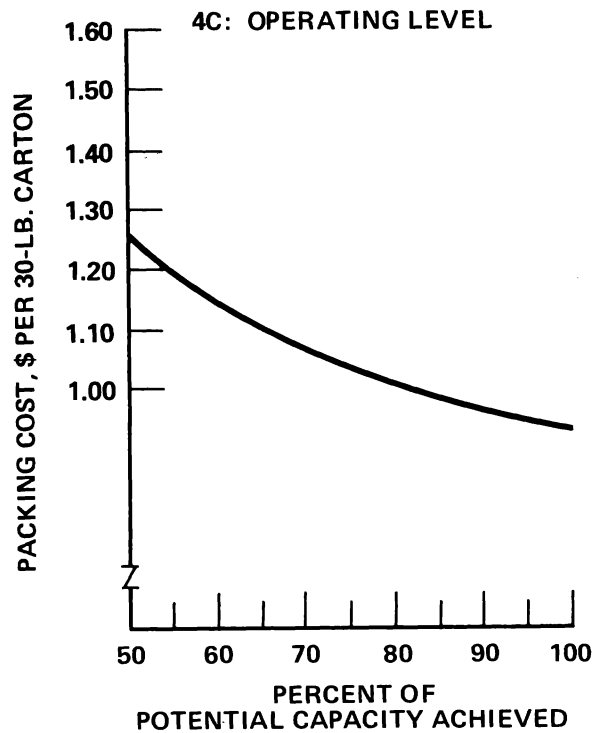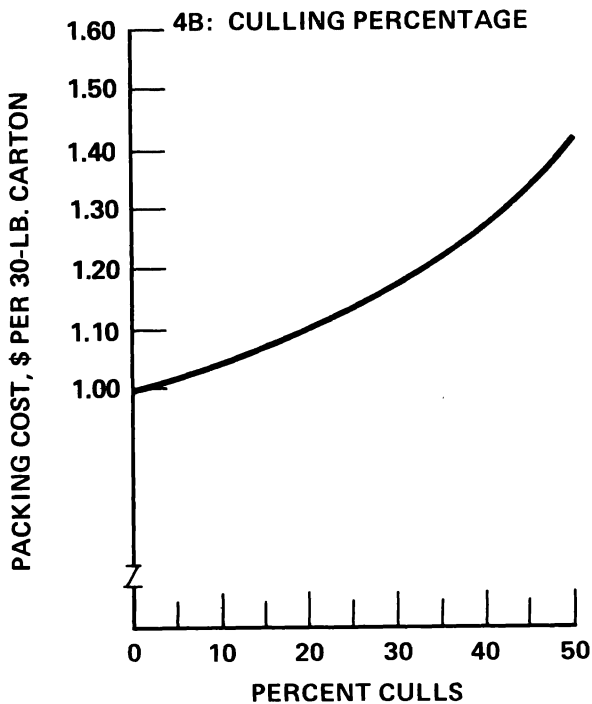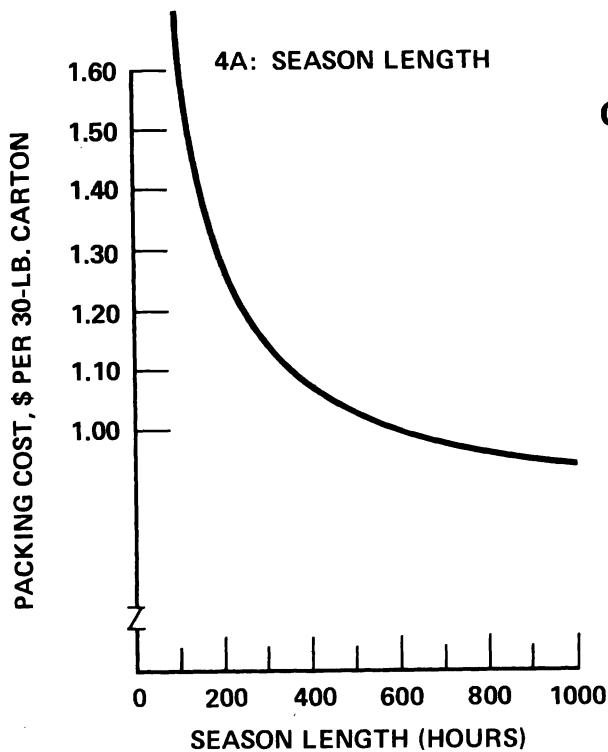
operations. Culling rates would affect harvest and transportation costs as well. Even more important, high culling percentages mean that large quantities of reject fruit are passing by sorters and the incidence of "missed" culls will be higher. The resulting reduction in packed product quality could seriously damage sales.

Figure 4C illustrates the effect on costs of operating level, or how close to potential capacity the model packinghouse actually operates. The maximum capacity of the model was specified at 30 tons per hour dumped, or 1,700 packed 30-pound boxes per hour at a 15-percent cull rate. However, operation at this rate over an entire season would not be possible due to mechanical failures, variability in fruit arrivals, and other factors. While operation at very low levels is costly, a limited amount of excess capacity adds little to unit packing costs (fig. 4C). Costs drop 20 cents in moving from 50 to 70 percent of maximum operating capacity, but only 10 cents in moving from 70 to 90 percent of maximum capacity.

One operating assumption which does not directly affect packing costs is the packout distribution with respect to percentages of vine-ripes, No. 1 greens, and No. 2 greens. Unit costs are invariable for percentages 15 percent above or below those specified (15 percent vine-ripe, 50 percent No. 1 greens, and 20 percent No. 2 greens). 21/ Beyond 15 percent, capacities of the individual packing stations are exceeded. It should also be noted that the packout distribution would materially affect the value of sales.

21/ This condition assumes that the total packinghouse crew remains on duty and all packing-line equipment continues to operate.

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Appendix table 1--Equipment specifications and costs, model California mature green tomato packinghouse

Stage	Equipment	Description	Units required	Initial unit	Cost (1973) total	Life	Electricity	Variable cost per hour 1/	Annual fixed cost 2/
				- - - - - Dollars - - - - -		Years	Horsepower	Cents	Dollars
Receive and dump									
Alternative #1 (bin dump)	Full bin	Wood construction, 4' x 4' x 24" 1,000-lb. capacity	1,200	30.00	36,000.00	5	--	180.00	9,900.00
	Forklift	Used, 20-ton capacity	2	4,000.00	8,000.00	10	--	3/,4/440.00	1,400.00
	Bin conveyer	Powered conveyer, through dump station, 4' x 24'	1	2,470.00	2,470.00	10	2	18.35	432.25
	Dump table	Hydraulic manual dumper with hopper and roller conveyer to pregrading table	1	6,462.00	6,462.00	10	4	44.32	1,130.85
Alternative #2 (trailer dump)	Bulk trailer	Steel construction, highway running gear, 4-ton cap.	50	2,000.00	100,000.00	15	--	500.00	14,167.00
	Tractor	Used, 30 horsepower	2	1,000.00	1,000.00	10	--	3/410.00	350.00
	Dump ramp	Steel and concrete const.	1	1,400.00	1,400.00	20	--	--	175.00
	Dump tank	Steel const., includes elevator and roller conveyer to pregrading table	1	8,225.00	8,225.00	10	--	--	1,439.38
Wash, dry, and wax	Washer	Equipment leased. Equipment wax,							
	Dryer	chlorine, and all maintenance							
	Waxer	furnished @ 4 cents/container							
	Buffer								
Sort and grade	Presizer (eliminator)	60" single frame with cross-conveyer for culls	1	1,410.00	1,410.00	10	1	7.05	246.75
	Pregrading table	60" x 15' roller conveyer for cull separation, center divider	1	3,525.00	3,525.00	10	1-1/2	22.12	616.88
	Main sorting table	60" x 34' belt-roll conveyer for color separation, grading, and culling, center divider	1	7,872.00	7,872.00	10	3	48.36	1,377.69
	Final grading belt	48" x 6' belt conveyer from main sorting table to sizer for final inspection	2	1,057.50	2,115.00	10	1-1/2	15.07	370.12
	Colored crossbelt	24" overhead conveyer for color separation	10 ft.	47.00	470.00	10	1/2	3.85	82.25
	#2 crossbelt	24" overhead conveyer for grade separation	70 ft.	47.00	3,290.00	10	2	22.45	575.75
Size #1									
Alternative #1	Belt sizer	4-48" x 4' frames + overflow, 4 sizes	2	5,287.50	10,575.00	10	3	61.87	1,850.62
Alternative #2	Weight sizer	8 lane, 3 sizing sections	1	15,628.00	15,628.00	10	2	84.13	2,734.81
Pack #1									
Alternative #1	Sizer runout conveyer	Conveyer from sizer to packing chutes	8	352.50	2,820.00	10	2	20.10	493.50
	Presizer	36" single frame with cross conveyer	4	1,057.50	4,230.00	10	2	27.15	740.25
	Manual filler	200 boxes/hr. maximum capacity	8	588.00	4,704.00	10	--	23.52	823.20
Alternative #2	Sizer runout conveyer		4	352.50	1,410.00	10	1	10.05	246.75
	Presizer		2	1,057.50	2,820.00	10	1	13.57	370.12
	Automatic filler	700 boxes/hr. maximum capacity	4	4,112.00	16,448.00	10	3	91.24	2,878.40
#2 Size and pack	Belt sizer	3-36" x 3' frames plus overflow. Packing chutes (gravity flow with drop-gate) attached	1	5,288.00	5,288.00	10	1-1/2	30.94	925.40
Sort, size, and pack colored fruit	Diversion conveyer	20" conveyer from colored pickoff belt to sorting table	20 ft.	41 ft.	820.00	10	3/4	6.35	143.50
	Main sorting table	48" x 20', divided roller conveyer table for color separation and culling. Includes raised worker platform	1	4,112.00	4,112.00	10	1	23.56	719.60
Alternative #1	Belt sizer, place pack	6-36" x 6' frames plus overflow, 4 sizes. Includes padded packing bins on both sides with movable dividers	1	11,750.00	11,750.00	10	2	64.75	2,056.25
Alternative #2	Belt sizer, volume fill	3-36" x ' frames plus overflow, 4 sizes. Includes gravity flow packing chutes on both sides of sizer	1	7,638.00	7,638.00	10	1-1/2	40.44	1,336.65
	Inline scale	Over-under scale in roller section of conveyer	1	700.00	700.00	10	--	3.25	122.50

See footnotes at end of table.

Appendix table 1--Equipment specifications and costs, model California mature green tomato packinghouse--Continued

Stage	Equipment	Description	Units required	Initial unit	Cost (1973) total	Life	Electricity	Variable cost per hour 1/	Annual fixed cost 2/
				- - - - - Dollars - - - - -		Years	Horsepower	Cents	Dollars
Convey, check weigh, lid, and store-filled containers	Filled container								
	#1 green		70 ft.		2,065.00	10	2	16.32	361.88
		12" powered							
	#2 green		70 ft.	29.50	2,065.00	10	2	16.32	361.38
	Colored		75 ft.		2,215.00	10	2	17.08	387.67
	Inline scales	Over-under scales in roller section of conveyer	3	700.00	2,100.00	10	--	10.50	367.50
Boxmaking and distribution	Monorail conveyer Green lines								
		Endless overhead chain with box hooks	175 ft.		2,056.00	10	1-3/4	15.53	359.80
				11.75					
	Colored lines		120 ft.		1,140.00	10	1-1/4	10.80	246.50
	#1 line box conveyer: through filling stations	12" powered conveyer	220 ft.	29.50	6,490.00	10	5-1/2	48.95	1,135.75
Cull removal	Cull belt	24" powered conveyer from cull collection points to elevator	140 ft.	41/ft.	5,740.00	10	2-1/2	36.20	1,004.50
	Elevator	24" to cull bin	1	2,350.00	2,350.00	10	1/2	13.25	411.25
	Cull bin	15-ton capacity, wood and steel construction	1	3,525.00	3,525.00	10	--	17.62	616.88
	Dump truck	For cull removal, used 5-yard capacity	1	1,000.00	1,000.00	10	--	3/55.00	175.00
Nonspecific	Miscellaneous equipment, office furniture, machines, and equipment		1 lot	5,000.00	5,000.00	10	--	25.00	875.00

-- = Not applicable.

1/ Calculated as 3 cents per motor horsepower plus .005 percent of initial cost for repairs.

2/ Depreciation based on straight-line method, repairs, insurance, taxes, and interest on investment.

3/ Includes gasoline and oil.

4/ For bin dumping only. Forklifts for container handling are leased.

Note: Capacities noted in the equipment descriptions are derived from manufacturers' specifications and may be optimistic in certain cases. Sufficient overcapacity was built into the model packinghouse so that equipment components are never required to operate at levels approaching maximum capacity.

Appendix table 2--Assumed labor standards for model California mature green tomato packinghouse

Stage and description	Units	Units per man-hour	Hourly wage 1/
			Dollars
Dump:			
Drive tractor (2 persons required)	Trailer	U 2/	3.00
Supervise dump station	"	U	3.29
Forklift bins from truck to temporary storage to dump conveyer	Full bin	U	3.35
Remove empty bins from conveyer and move to truck or storage	" "	U	3.35
Operate automatic dump table...	" "	U	3.29
Total crew: Trailer dump--3			
Bin dump--3			
Sorting:			
Main grading table:			
Cull removal	Pounds	3/ 500-9,500	
Color removal	"	3/ 500-9,500	
Cull and grade separation	"	3/ 1,500-3,000	
Colored sorting table:			2.78
Separate two colors, remove culls	"	3/ 1,500-3,500	
Total crew: 46			
Pack:			
Supervise automatic filling unit	30-lb. box	U	3.29
Operate manual filling unit:			
With conveyer assist 4/	" "	200	3.06
Without conveyer assist 5/	" "	125	3.06
Place pack colored fruit (remove box from monorail, pack, stamp, size,			
place on take-away conveyer)	25-lb. equiv.	3/25-35	Piece rate
Total crew: Greens--automatic fill #1--5			
manual fill #1--12			
Pinks--place pack --12			
volume fill--4			
Tally, check-weigh, and lid:			
Check-weigh--remove or add fruit to achieve tolerance	30-lb. box	500	2.76
Position telescopic lid	" "	700	3.00
Tally by size and grade (and color for vine-ripes)	Box 6/	U	2.78
Fasten interlocking lid (flats and lugs)	Flat or lug	800	3.00
Total crew: volume fill all fruit--11			
place pack vine-ripes--10			
Store and load:			
Remove filled containers from take-away conveyers, palletize by			
(color), grade, and size	Box 6/	350	3.00
Forklift pallets to cooler or temporary storage	"	U	3.35
Transport pallets from storage and load with forklift	"	925	3.29
Transport pallets from storage by forklift and load by hand with roller			
conveyer assist	"	600	3.29
Total crew: 13 7/			
Box assembly and distribution:			
Assemble flats and lugs (hand-assembly using jig)	Flat or lug	125	2.76
Assemble 30-pound cartons (machine assembly)	30-lb. box	8/900	3.00
Assemble telescopic lids (machine assembly)	" "	9/600	3.17
Place box on monorail conveyer	Box 5/	800	2.75
Remove box from monorail, stamp, size, and position on conveyer to			
filler (#1 line)	30-lb. box	400	2.76
Miscellaneous and unclassified:			
Assist on bottleneck locations, minor repairs, cleanup, cull removal,			
and other miscellaneous duties			2.76
Total crew--4			

1/ Union scale plus 17.5 percent for fringe benefits.

2/ The letter U indicates potential performance greater than required. That is, the crew requirement for these jobs is determined by factors other than physical capabilities, and the potential units per man-hour are greater than needed under peak operating conditions.

3/ Point estimates of labor standard not given because of wide variability in performance due to fruit quality, rates of flow, worker quality, and other factors. Midpoints of the ranges shown are used to establish crew requirements.

4/ Stamped boxes conveyed beneath filling stations; worker rolls box into position, operates dump chute gate, and rolls filled box out of position.

5/ Worker removes box from monorail, stamps size, fills, and carries box to take-away conveyer.

6/ The term, "box", in the units column refers to either flats and lugs or 30-pound containers.

7/ Assumes 25 percent of total output shipped by truck, 75 percent by rail.

8/ Box-making machine capacity is 1,800 boxes per hour, but two employees are required to operate a machine at this capacity.

9/ Standard for one worker unassisted. With two employees, units per man-hour increase to 1,000.